biophysical journal

Published monthly for the Biophysical Society
by The Rockefeller University Press.
Edited by the Biophysical Society in cooperation
with the Division of Biological Physics
of The American Physical Society

Editorial Board

Editor
Thomas E. Thompson

Associate Editors
Rodney L. Biltonen
Elias Greenbaum
Howard Kutchai

Leonard J. Banaszak
Victor Bloomfield
Robert G. Bryant
Robert Callender
Donald M. Crothers
Louis J. DeFelice
Donald S. Faber
John Gergely
Meyer B. Jackson
Ken Jacobson
Martin Karplus
Ira Levin
Lee Makowski
C. Robert Matthews
Richard L. Moss
John C. Owicki
Linda S. Powers
Charles E. Swenberg
Gabor Szabo
David D. Thomas
Samuel Williamson
George I. Zahalak

Volume 59

New York

1991

copyright © 1991

by biophysical society

contents

january 1991
volume 59
number 1

1 In memory of Peter Läuger
Günther Stark

articles

4 Proton transfer dynamics in the nonhomogeneous electric field of a protein
Ruth Yam, Esther Nachliel, Smadar Kiryati, Menachem Gutman, and Dan Huppert

12 Imaging of calcium transients in skeletal muscle fibers
Julio Vergara, Marino DiFranco, Deida Compagnon, and Benjamin A. Suarez-Isla

25 Formation of liquid crystalline phase of actin filament solutions and its dependence on filament length as studied by optical birefringence
Atsushi Suzuki, Tadakazu Maeda, and Tadanao Ito

31 Slow motions in lipid bilayers. Direct detection by two-dimensional solid-state deuterium nuclear magnetic resonance
Michèle Auger, Ian C. P. Smith, and Harold C. Jarrell

39 Is swelling of the secretory granule matrix the force that dilates the exocytotic fusion pore?
Jonathan R. Monck, Andres E. Oberhauser, Guillermo Alvarez de Toledo, and Julio M. Fernandez

48 Multifrequency calorimetry of the folding/unfolding transition of cytochrome *c*
William W. van Osdol, Obdulio L. Mayorga, and Ernesto Freire

55 Phosphorus-31 two-dimenstional solid-state exchange NMR. Application to model membrane and biological systems
David B. Fenske and Harold C. Jarrell

70 Circular dichroism and photocycle kinetics of partially detergent solubilized and partially retinal regenerated bacteriorhodopsin
Shuguang Wu, Elias S. Awad, and M. A. El-Sayed

76 Biophysical properties of gap junctions between freshly dispersed pairs of mouse pancreatic beta cells
Martha Pérez-Armendariz, Christine Roy, David C. Spray, and Michael V. L. Bennett

93 Relation between left ventricular cavity pressure and volume and systolic fiber stress and strain in the wall
Theo Arts, Peter H. M. Bovendeerd, Frits W. Prinzen, and Robert S. Reneman

103 Lanthanide-induced phosphorus-31 NMR downfield chemical shifts of lysophosphatidylcholines are sensitive to lysophospholipid critical micelle concentration
V. V. Kumar and Wolfgang J. Baumann

108 Molecular areas of phospholipids as determined by ^{2}H NMR spectroscopy. Comparison of phosphatidylethanolamines and phosphatidylcholines
Robin L. Thurmond, Steven W. Dodd, and Michael F. Brown

114 A voltage-dependent gap junction in *Drosophila melanogaster*
Vytas K. Verselis, Michael V. L. Bennett, and Thaddeus A. Bargiello

127 Orientation of spin-labeled light chain-2 exchanged onto myosin cross-bridges in glycerinated muscle fibers
Brett Hambly, Kathleen Franks, and Roger Cooke

139 Dielectric behavior of the frog lens in the 100 Hz to 500 MHz range. Simulation with an allocated ellipsoidal-shells model
Makio Watanabe, Toshinobu Suzaki, and Akihiko Irimajiri

150 Single inward rectifier potassium channels in guinea pig ventricular myocytes. Effects of quinidine
J. R. Balser, D. M. Roden, and P. B. Bennett

162 Fluid bilayer structure determination by the combined use of x-ray and neutron diffraction. I. Fluid bilayer models and the limits of resolution
Michael C. Wiener and Stephen H. White

174 Fluid bilayer structure determination by the combined use of x-ray and neutron diffraction. II. "Composition-space" refinement method
Michael C. Wiener and Stephen H. White

186 Nanosecond fluorescence microscopy. Emission kinetics of Fura-2 in single cells
Susan M. Keating and Theodore G. Wensel

203 Sodium-23 NMR relaxation times in nucleated red blood cells and suspensions of nuclei
Hadassah Shinar and Gil Navon

209 Membrane conductance of an electroporated cell analyzed by submicrosecond imaging of transmembrane potential
Masahiro Hibino, Masaya Shigemori, Hiroyasu Itoh, Kuniaki Nagayama, and Kazuhiko Kinosita, Jr.

221 NMR spin grouping and correlation exchange analysis. Application to low hydration NaDNA paracrystals
L. J. Schreiner, J. C. MacTavish, M. M. Pintar, and A. Rupprecht

235 Influence of external chloride concentration on the kinetics of mobile charges in the cell membrane of *Valonia utricularis*. Evidence for the existence of a chloride carrier
Jianning Wang, Günter Wehner, Roland Benz, and Ulrich Zimmermann

brief communications

249 Steady and transient behaviors of protoplasmic streaming in *Nitella* internodal cell
Yoshimi Tsuchiya, Hiromichi Yamazaki, and Tomokazu Aoki

252 Metastable ripple phase of fully hydrated dipalmitoylphosphatidylcholine as studied by small angle x-ray scattering
Haruhiko Yao, Sinzi Matuoka, Boris Tenchov, and Ichiro Hatta

256 Correction

257 Correction

february 1991
volume 59
number 2

261 Monte Carlo simulation studies of lipid order parameter profiles near integral membrane proteins
Maria M. Sperotto and Ole G. Mouritsen

271 General continuum theory for multiion channel. I. Theory
David G. Levitt

278 General continuum theory for multiion channel. II. Application to acetylcholine channel
David G. Levitt

289 Structure of an adsorbed dimyristoylphosphatidylcholine bilayer measured with specular reflection of neutrons
Shirley J. Johnson, Thomas M. Bayerl, Douglas C. McDermott, Giles W. Adam, Adrian R. Rennie, Robert K. Thomas, and Erich Sackmann

295 Nonstationary fluctuation analysis and direct resolution of single channel currents at postsynaptic sites
Hugh P. C. Robinson, Yoshinori Sahara, and Nobufumi Kawai

305 Conformational relaxation of a low-temperature protein as probed by photochemical hole burning. Horseradish peroxidase
J. Zollfrank, J. Friedrich, J. M. Vanderkooi, and J. Fidy

313 Distortions in the photocycle of the bacteriorhodopsin at moderate dehydration
György Váró and Janos K. Lanyi

323 Chemical exchange in two dimensions in the 1H NMR assignment of cytochrome *c*
Yiqing Feng, A. Joshua Wand, Heinrich Roder, and S. Walter Englander

329 Two step mechanism of phosphate release and the mechanism of force generation in chemically skinned fibers of rabbit psoas muscle
Masataka Kawai and Herbert R. Halvorson

343 A physical model of ATP-induced actin-myosin movement in vitro
Katsuhisa Tawada and Ken Sekimoto

357 Vesicle sizing. Number distributions by dynamic light scattering
F. R. Hallett, J. Watton, and P. Krygsman

363 Vibrational modes of hemoglobin in red blood cells
P. Martel, P. Calmettes, and B. Hennion

375 Reaction rate and collisional efficiency of the rhodopsin-transducin system in intact retinal rods
Martina Kahlert and Klaus Peter Hofmann

387 Two-dimensional crystals of streptavidin on biotinylated lipid layers and their interactions with biotinylated macromolecules
Seth A. Darst, Michael Ahlers, Paul H. Meller, Elizabeth W. Kubalek, Rainer Blankenburg, Hans O. Ribi, Helmut Ringsdorf, and Roger D. Kornberg

397 The dependence of the shapes of fluorescence induction curves in chloroplasts on the duration of illumination pulses
Leonas Valkunas, Nicholas E. Geacintov, Lee France, and Jacques Breton

409 Adsorption of α-helical antifreeze peptides on specific ice crystal surface planes
C. A. Knight, C. C. Cheng, and A. L. DeVries

419 Monte Carlo simulation of the water in a channel with charges
Michael E. Green and Joseph Lewis

427 Light-induced proton permeability changes in retinal rod photoreceptor disk membranes
H. Gilbert Smith and Roger S. Fager

433 Photon correlation spectroscopy of light scattered by eye lenses in in vivo conditions
M. Van Laethem, B. Babusiaux, A. Neetens, and J. Clauwaert

445 Lipid-cholesterol interactions. Monte Carlo simulations and theory
H. L. Scott

456 Growth conditions control the size and order of actin bundles in vitro
David L. Stokes and David J. DeRosier

466 A photophysical model for diphenylhexatriene fluorescence decay in solvents and in phospholipid vesicles
Tiziana Parasassi, Gelsomina De Stasio, Ruth M. Rusch, and Enrico Gratton

476 Solving complex photocycle kinetics. Theory and direct method
John F. Nagle

488 Location of high-affinity metal binding sites in the profile structure of the Ca^{+2}-ATPase in the sarcoplasmic reticulum by resonance x-ray diffraction
Francisco J. Asturias and J. Kent Blasie

brief communication

503 Existence of Q_γ in frog cut twitch fibers with little Q_β
Wei Chen and Chiu Shuen Hui

march 1991
volume 59
number 3

509 Interstitial potential during propagation in bathed ventricular muscle
Stephen B. Knisley, Toru Maruyama, and Jack W. Buchanan, Jr.

516 Fourier transform infrared evidence for a predominantly alpha-helical structure of the membrane bound channel forming COOH-terminal peptide of colicin E1
P. Rath, O. Bousché, A. R. Merrill, W. A. Cramer, and K. J. Rothschild

523 Competitive binding interaction between Zn^{2+} and saxitoxin in cardiac Na^+ channels. Evidence for a sulfhydryl group in the Zn^{2+}/saxitoxin binding site
Laurent Schild and Edward Moczydlowski

538 Hydration pressure between lipid bilayers. Comparison of measurements using x-ray diffraction and calorimetry
Sidney A. Simon, Cynthia A. Fink, Anne K. Kenworthy, and Thomas J. McIntosh

547 Model for synchronization of pancreatic β-cells by gap junction coupling
Arthur Sherman and John Rinzel

560 Kinetic analysis of antagonist action at *N*-methyl-D-aspartic acid receptors. Two binding sites each for glutamate and glycine
Morris Benveniste and Mark L. Mayer

574 Gating current kinetics in *Myxicola* giant axons. Order of the back transition rate constants
L. Goldman

590 Conformational heterogeneity of creatine kinase determined from phase resolved fluorometry
Steven H. Grossman

598 Mechanics of glycerinated muscle fibers using nonnucleoside triphosphate substrates
E. Pate, K. L. Nakamaye, K. Franks-Skiba, R. G. Yount, and R. Cooke

606 Small angle x-ray scattering of chromatin. Radius and mass per unit length depend on linker length
Shawn P. Williams and John P. Langmore

619 Fluorescence measurements of immune complexes of Mab 4-4-20 with isomeric haptens
Cathy A. Swindlehurst and Edward W. Voss, Jr.

629 Proton NMR spin grouping and exchange in dentin
L. J. Schreiner, I. G. Cameron, N. Funduk, L. Miljković, M. M. Pintar, and D. N. Kydon

640 Fourier transform infrared studies of active-site-methylated rhodopsin. Implications for chromophore-protein interaction, transducin activation, and the reaction pathway
Ulrich M. Ganter, Colin Longstaff, Maria A. Pajares, Robert R. Rando, and Friedrich Siebert

645 Location of two antioxidants in oriented model membranes. Small-angle x-ray diffraction study
J. Katsaras, R. H. Stinson, J. H. Davis, and E. J. Kendall

654 Resolution of phospholipid conformational heterogeneity in model membranes by spin-label EPR and frequency-domain fluorescence spectroscopy
Thomas C. Squier, James E. Mahaney, J. J. Yin, Ching San Lai, and Joseph R. Lakowicz

670 Microscopic theory of the dielectric properties of proteins
Thomas Simonson, David Perahia, and Axel T. Brünger

691 Effect of cholesterol and lanosterol on the structure and dynamics of the cell membrane of *Mycoplasma capricolum*. Deuterium nuclear magnetic resonance study
Tai-huang Huang, August J. DeSiervo, and Qing-Xian Yang

703 Diffusion around a cardiac calcium channel and the role of surface bound calcium
Donald M. Bers and Arthur Peskoff

722 Quantitative video microscopy of patch clamped membranes stress, strain, capacitance, and stretch channel activation
Masahiro Sokabe, Frederick Sachs, and Zhongqi Jing

729 Dynamics of glycolipids in the liquid-crystalline state. ^{2}H NMR study
Beatrice G. Winsborrow, Ian C. P. Smith, and Harold C. Jarrell

742 Protein dynamics. Comparative investigation on heme-proteins with different physiological roles
Ernesto E. Di Iorio, Urs R. Hiltpold, Dorde Filipovic, Kaspar H. Winterhalter, Enrico Gratton, Eugenio Vitrano, Antonio Cupane, Maurizio Leone, and Lorenzo Cordone

brief communication

755 Atomic force microscopy of hydrated phosphatidylethanolamine bilayers
J. A. N. Zasadzinski, C. A. Helm, M. L. Longo, A. L. Weisenhorn, A. C. Gould, and P. K. Hansma

april 1991
volume 59
number 4

765 Effect of aniosmotic media on the volume of the T-lymphocyte nucleus
Alfons G. Hoekstra, Jacob A. Aten, and Peter M. A. Sloot

775 Relaxation dynamics of the gel to liquid-crystalline transition of phosphatidylcholine bilayers. Effects of chainlength and vesicle size
William W. van Osdol, Michael L. Johnson, Qiang Ye, and Rodney L. Biltonen

786 Effective pore radius of the gramicidin channel. Electrostatic energies of ions calculated by a three-dielectric model
Hiroshi Monoi

795 Collective vibrations of an α-helix. A molecular dynamics study
Jürgen Pleiss and Fritz Jähnig

805 Structural studies of tropomyosin by cryoelectron microscopy and x-ray diffraction
Donna Cabral-Lilly, George N. Phillips, Jr., Gina E. Sosinsky, Linda Melanson, Susan Chacko, and Carolyn Cohen

815 Dynamic measurements of the platelet membrane glycoprotein II_b-III_a receptor for fibrinogen by flow cytometry. I. Methodology, theory, and results for two distinct activators
Mony Frojmovic, Truman Wong, and Theo van de Ven

828 Dynamic measurements of the platelet membrane glycoprotein II_b-III_a receptor for fibrinogen by flow cytometry. II. Platelet size-dependent subpopulations
Mony Frojmovic and Truman Wong

838 Detachment of agglutinin-bonded red blood cells. I. Forces to rupture molecular-point attachments
E. Evans, D. Berk, and A. Leung

849 Detachment of agglutinin-bonded red blood cells. II. Mechanical energies to separate large contact areas
E. Evans, D. Berk, A. Leung, and N. Mohandas

861 Detachment of agglutinin-bonded red blood cells. III. Mechanical analysis for large contact areas
D. Berk and E. Evans

873 "Reversed" alamethicin conductance in lipid bilayers
Robert J. Taylor and Robert de Levie

880 Cross-helix separation of tropomyosin molecules in acto-tropomyosin as determined by neutron scattering
D. B. Bivin, D. B. Stone, D. K. Schneider, and R. A. Mendelson

889 Ionic channels in Langmuir-Blodgett films imaged by a scanning tunneling microscope
Oleg V. Kolomytkin, Alexander O. Golubok, Dmitri N. Davydov, Vladimir A. Timofeev, Svetlana A. Vinogradova, and Serge Ya. Tipisev

894 Structural investigation of the covalent and electrostatic binding of yeast cytochrome *c* to the surface of various ultrathin lipid multilayers using x-ray diffraction
James M. Pachence and J. Kent Blasie

901 Small iminium ions block gramicidin channels in lipid bilayers
Greg Hemsley and David Busath

908 Carboxy Mb at pH 3. Time-resolved resonance Raman study at cryogenic temperatures
I. E. T. Iben, B. R. Cowen, R. Sanches, and J. M. Friedman

brief communications

920 Voltage-dependent gap junction channels are formed by connexin32, the major gap junction protein of rat liver
Alonso P. Moreno, Antonio C. Campos de Carvalho, Vytas Verselis, Behrok Eghbali, and David C. Spray

926 Nonuniform volume changes during muscle contraction
Ian R. Neering, Laura A. Quesenberry, V. Arlene Morris, and Stuart R. Taylor

934 What spectroscopy can still tell us about the secondary structure of bacteriorhodopsin
R. M. Glaeser, K. H. Downing, and B. K. Jap

939 Measurement of voltage dependence of capacitance of planar bilayer lipid membrane with a patch clamp amplifier
S. Toyama, A. Nakamura, and F. Toda

945 Aging and the complexity of cardiovascular dynamics
Daniel T. Kaplan, Mark I. Furman, Steven M. Pincus, Sheila M. Ryan, Lewis A. Lipsitz, and Ary L. Goldberger

950 Microscopic versus macroscopic diffusion in model membranes by ESR spectral-spatial imaging
Y.-K. Shin, U. Ewert, D. E. Budil, and J. H. Freed

may 1991
volume 59
number 5

961 Ion transport in a model gramicidin channel. Structure and thermodynamics
Benoît Roux and Martin Karplus

982 Determination of electric parameters of cell membranes by a dielectrophoresis method
P. Marszalek, J. J. Zielinsky, M. Fikus, and Tian Y. Tsong

988 Picosecond decay kinetics and quantum yield of fluorescence of the photoactive yellow protein from the halophilic purple phototrophic bacterium, *Ectothiorhodospira halophila*
T. E. Meyer, G. Tollin, T. P. Causgrove, P. Cheng, and R. E. Blankenship

992 Polarized fluorescence measurements on ordered photosynthetic antenna complexes. Chlorosomes of *Chloroflexus aurantiacus* and B800–B850 antenna complexes of *Rhodobacter sphaeroides*
H. van Amerongen, B. van Haeringen, M. van Gurp, and R. van Grondelle

1002 Tension and instantaneous stiffness of single muscle fibers immersed in Ringer solution of decreased tonicity
Bernard H. Bressler and Kevin Matsuba

1007 Raman spectroscopic studies of dimyristoylphosphatidic acid and its interactions with ferricytochrome *c* in cationic binary and ternary lipid-protein complexes
James S. Vincent and Ira W. Levin

1022 Reversible condensation of mast cell secretory products in vitro
Julic M. Fernandez, Manuel Villalón, and Pedro Verdugo

1028 Cell-attached patch clamp study of the electropermeabilization of amphibian cardiac cells
Rory J. O'Neill and Leslie Tung

1040 Gd^{3+} vibronic side band spectroscopy. New optical probe of Ca^{2+} binding sites applied to biological macromolecules
I. E. T. Iben, M. Stavola, R. B. Macgregor, X. Y. Zhang, and J. M. Friedman

1050 Influence of the frezing process upon fluoride binding to hemeproteins
An-Suei Yang and Arthur S. Brill

1064 Domains and anomalous adsorption isotherms of dipalmitoylphosphatidylcholine membranes and lipophilic ions: pentachlorophenolate, tetraphenylborate, and dipicrylamine
Pavel Smejtek and Shanru Wang

1074 Dipole interactions in electrofusion. Contributions of membrane potential and effective dipole to interaction pressures
David A. Stenger, Karan V. I. S. Kaler, and Sek Wen Hui

1085 Abnormal human sarcoplasmic reticulum Ca^{2+} release channels in malignant hyperthermic skeletal muscle
Michael Fill, Enrico Stefani, and Thomas E. Nelson

1091 Effect of the synergistic anion on electron paramagnetic resonance spectra of iron-transferrin anion complexes is consistent with bidentate binding of the anion
Jean Dubach, Betty Jean Gaffney, Kundalika More, Gareth R. Eaton, and Sandra S. Eaton

1101 Refinement of the main chain directed assignment strategy for the analysis of ^1H NMR spectra of proteins
A. Joshua Wand and Sarah J. Nelson

1113 Implementation of the main chain directed assignment strategy. Computer assisted approach
Sarah J. Nelson, Diane M. Schneider, and A. Joshua Wand

1123 Restoring forces in cardiac myocytes. Insight from relaxations induced by photolysis of caged ATP
E. Niggli and W. J. Lederer

brief communications

1136 Diffusion model of ion channel gating. Extension to agonist-activated ion channels
Robert E. Oswald, Glenn L. Millhauser, and Alison A. Carter

letters to the editor

1143 Stochastic models for mechanical transduction
Frederick Sachs and Harold Lecar

1146 Correction

june 1991
volume 59
number 6

1153 Nonmammalian vertebrate skeletal muscles express two triad junctional foot protein isoforms
Enrique B. Olivares, Steven J. Tanksley, Judith A. Airey, Claudia F. Beck, Yannan Ouyang, Thomas J. Deerinck, Mark H. Ellisman, and John L. Sutko

1164 Open channel block by gadolinium ion of the stretch-inactivated ion channel in *mdx* myotubes
Alfredo Franco, Jr., Bruce D. Winegar, and Jeffrey B. Lansman

1171 Differential polarization imaging. IV. Images in higher born approximations
Myeonghee Kim and Carlos Bustamante

1183 Differential polarization imaging. V. Numerical aperture effects and absorption to the circular dichroism images
Laura Finzi, Laura Ulibarri, and Carlos Bustamante

1194 Measuring elastic properties of cells by evaluation of scanning acoustic microscopy $V(Z)$ values using simplex algorithm
T. Kundu, J. Bereiter-Hahn, and K. Hillmann

1208 Heterogeneity in ATP-dependent acidification in endocytic vesicles from kidney proximal tubule. Measurement of pH in individual endocytic vesicles in a cell-free system
Lan-Bo Shi, Kiyohide Fushimi, Hae-Rahn Bae, and A. S. Verkman

1218 Model for the dynamic responses of taste receptor cells to salty stimuli. I. Function of lipid bilayer membranes
Masayoshi Naito, Nobuko Fuchikami, Naoyuki Sasaki, and Takeshi Kambara

1235 Rotational dynamics of spin-labeled F-actin during activation of myosin S1 ATPase using caged ATP
E. Michael Ostap and David D. Thomas

1242 On the relationship between distance information derived from cross-linking and from resonance energy transfer, with specific reference to sites located on myosin heads
Peter D. Chantler, Terence Tao, and Walter F. Stafford III

1251 Characterization of ion channels on the surface membrane of adult rat skeletal muscle
Michael Chua and William J. Betz

1261 Orientation of specifically $^{13}C{=}O$ labeled phosphatidylcholine multilayers from polarized attenuated total reflection FT-IR spectroscopy
Wigand Hubner and Henry H. Mantsch

1273 Time-resolved changes in equatorial x-ray diffraction and stiffness during rise of tetanic tension in intact length-clamped single muscle fibers
G. Cecchi, P. J. Griffiths, M. A. Bagni, C. C. Ashley, and Y. Maeda

1284 Osmotically induced electrical signals from actin filaments
Horacio F. Cantiello, Charles Patenaude, and Ken Zaner

1290 Monte Carlo simulation of miniature endplate current generation in the vertebrate neuromuscular junction
Thomas M. Bartol Jr., Bruce R. Land, Edwin E. Salpeter, and Miriam M. Salpeter

1308 Frequency and concentration windows for the electric activation of a membrane active transport system
Vladislav S. Markin and Tian Y. Tsong

1317 Reversible mechanosensitive ion pumping as a part of mechanoelectrical transduction
Vladislav S. Markin and Tian Y. Tsong

brief communication

1324 Structural properties of phosphatidylcholine in a monolayer at the air/water interface. Neutron reflection study and reexamination of x-ray reflection measurements
David Vaknin, Kristian Kjaer, Jens Als-Nielsen, and Mathias Lösche